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Attorney Docket No. 5051.441 PATENT

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re:	DeSimone et. al.	Confirmation No:	7597
Serial No.:	09/641,815	Group Art Unit:	1764
Filed:	August 18, 2000	Examiner:	Norton, Nadine G.

For: *CARBON DIOXIDE-SOLUBLE POLYMERS AND SWELLABLE POLYMERS FOR CARBON DIOXIDE APPLICATIONS*

Date: September 15, 2003

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPELLANT'S BRIEF ON APPEAL UNDER 37 C.F.R. § 1.192

Sir:

This Appeal Brief is filed pursuant to the "Notice of Appeal to the Board of Patent Appeals and Interferences" filed on July 14, 2003 and is filed in triplicate pursuant to 37 C.F.R. § 1.192.

REAL PARTY IN INTEREST

The real party in interest is North Carolina State University, an educational institution having a principle place of business at 1 Holliday Hall, Campus Box 7003, Raleigh, North Carolina, the Assignee of this application.

RELATED APPEALS AND INTERFERENCES

Appellants are unaware of any related appeals and/or interferences that will directly or indirectly affect this Appeal or have any bearing on the Board's decision in this Appeal.

STATUS OF CLAIMS

Claims 1-9, 11-13, 18-20, and 49 are pending in this case and stand rejected.

Claims 1-7 and 20 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Tacke et al. (U.S. Pat. No. 5,734,070).

Claims 1, 2, 4-9, 11-13, and 18-20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Bitler et al. (U.S. Pat. No. 6,255,367) in view of the reference "Supercritical Fluids in Heterogeneous Catalysis" by Baiker.

The Office has repeatedly indicated that Claim 49 is rejected. None of the Actions, however, indicate the reasons for which Claim 49 is rejected. It will be assumed for the purposes of this Appeal Brief that Claim 49 is only rejected under 35 U.S.C. § 103(a) as being unpatentable over Bitler et al. in view of Baiker because Claim 11, from which Claim 49 depends, is rejected for those reasons.

STATUS OF AMENDMENTS

A Final Office Action dated March 13, 2003 ("Final Action") rejected Claims 1-9, 11-13, 18-46 and 49-64, which were pending in the case at that time. Remarks to the Final Action did not place the Claims in condition for Allowance and an Advisory Action dated June 25, 2003 ("First Advisory Action") was issued upholding the rejection of all of the pending claims. An amendment in response to the First Advisory Action was filed which requested the cancellation of Claims 50-64 to put the case in better condition for Appeal. The amendment was entered in an Advisory Action dated July 23, 2003 ("Second Advisory Action"). The Second Advisory Action reiterated the rejection of the pending claims.

A Notice of Appeal was filed on July 14, 2003.

SUMMARY OF THE INVENTION

The presently claimed invention provides methods for carrying out catalytic reactions in carbon dioxide. *See, Specification* at p. 3, lines 2-3. In particular, the invention comprises contacting a fluid mixture with a catalyst bound to a polymer wherein the polymer is soluble in carbon dioxide. *See, Id.* at lines 3-5 and 7-8. Carbon dioxide in a gas, liquid, or supercritical

state is employed as a solvent in the methods of the present invention. *See, Id.* at p. 4, lines 32-33. The catalytic reactions may include hydrogenation reactions, hydrofomylation reactions, epoxidation reactions and carbon-carbon coupling reactions. *See, Id.* at p. 13, lines 31-34.

According to embodiments of the invention, the carbon dioxide soluble polymers "include both fully soluble and partially soluble polymers, as long as some of the polymer is solubilized in the carbon dioxide." *See, Specification* at p. 6, lines 13-16. The soluble polymers used "are preferably polymers that contain a CO_2-philic group, and which polymers are soluble in carbon dioxide." *See, Id.* at lines 27-32. Examples of CO_2-philic groups used with the soluble polymers are detailed in the Specification, and in particular at page 6, line 33 to page 7, line 27.

The carbon dioxide soluble polymers of the present invention "may consist entirely of the CO_2-philic group, or may be a copolymer of a CO_2-philic group and a group that is not otherwise soluble in CO_2 ("CO_2-phobic")." *See, Specification* at p. 7, lines 28-30. In some embodiments of the invention, the carbon dioxide soluble polymer may include a CO_2-philic backbone that is primarily comprised of a fluorpolymer such as those derived from fluorinated acrylate or methacrylate monomers. *See, Id.* at p. 8, lines 7-10. "Other suitable CO_2-soluble materials for the composition of the polymeric backbone include fluorinated ethers, silicones, and phosphazenes." *See, Id.* at lines 10-11.

Catalysts suitable for use with the methods of the present invention include metal catalysts and enzymatic catalysts. *See, Specification* at p. 10, lines 17 and 28. The catalysts may be incorporated into the polymers in various ways. *See, Id.* at . 11, lines 22-24 and 30-32. Suitable metal catalysts include transition metal catalysts such as ruthenium, rhodium, palladium, platinum, vanadium, and molybdenum and fluorous-soluble materials. *See, Id.* at p. 10, lines 16-26. Suitable enzymatic catalysts include alcohol dehydrogenases, alcohol oxidase, aldolase, phosphatases, alpha-chymotrypsin, asparaginase, anhydrase, catalase, creatine kinase, glutaminase, oxidases, lipases, luciferase, urease, hydratase, peroxidase, subtilisin Carlsberg and BPN', thermolysin, superoxidase, nitrileamidase, esterases, transaminase, trypsin, fumarase,

amidase, acylase, peptidases, carboxylases, RNAses, glycolases, transeferases, and enzymes. *See, Id.* at p. 10, line 30 to p. 11, line 5.

Ligands that may be used to attach the catalysts to the polymers include ligands that are attached to the polymer backbone. *See, Specification* at p. 11, lines 32-34. Examples of such ligands include β-diketone, phosphate, phosphite, salen, bis imine, pyridine-bisimine, imidazole, pyrazolyl borate, pyridine, bi- and tripyridine, porphyrin, phthalocyanine, cyclopentadienyl, phosphonate, phosphinic acid, phosphine, thiophosphinic acid, dithiocarbamate, amino, ammonium, hydroxyoxime, hydroxamic acid, calix(4)arene, macrocyclic , crown ether, 8-hydroxyquinoline, picolylamine, thiol, carboxylic acid ligands, chiral ligands, monodentate ligands, polydentate ligands, and mixtures thereof. *See, Id.* at p. 12, lines 3-11.

ISSUES

1. Whether Claims 1-7 and 20 are anticipated by Tacke et al. (U.S. Pat. No. 5,734,070) under 35 U.S.C. § 102(b).

2. Whether Claims 1, 2, 4-9, 11-13, and 18-20 are obvious over Bitler et al. (U.S. Pat. No. 6,255,367) in view of the reference to Baiker entitled "Supercritical Fluids in Heterogeneous Catalysis" under 35 U.S.C. § 103(a).

3. Whether Claim 49 is obvious under 35 U.S.C. § 103(a) in light of Bitler et al. (U.S. Pat. No. 6,255,367) in view of the reference to Baiker entitled "Supercritical Fluids in Heterogeneous Catalysis."

GROUPING OF CLAIMS

The appealed claims are Claims 1-9, 11-13, 18-20, and 49. The following is the grouping of the claims for this Appeal:

(a) Claims 1-9, 11-13, 18-20, and 49 stand and fall together.

ARGUMENT

Claims 1-7 and 20 are not anticipated by Tacke et al. because Tacke et al. does not expressly or inherently describe all of the elements of those claims. Furthermore, none of Claims 1, 2, 4-9, 11-13, 18-20, and 49 are obvious in light of the combination of Bitler et al. and Baiker because all of the requirements to support a *prima facie* obviousness rejection are not found in the cited references or the knowledge generally available to those skilled in the art. For at least the reasons stated herein, and those stated previously in the record, Claims 1-9, 11-13, 18-20, and 49 are allowable over the outstanding rejections.

1. 35 U.S.C. § 102(b) Rejection based on Tacke et al.

Claims 1-7 and 20 are rejected under 35 U.S.C. § 102 as being anticipated by Tacke et al. Claim 1-7 and 20 stand and fall together under the anticipation rejection, and more particularly, Claims 2-7 and 20 stand and fall with Claim 1.

Claim 1 specifically recites a method comprising "contacting a fluid mixture with a catalyst bound to a polymer...wherein the polymer is soluble in carbon dioxide." (emphasis added). Claims 2-7 and 20 each depend from Claim 1. Tacke et al. does not propose catalysts bound to polymers that are soluble in carbon dioxide as claimed. Under 35 U.S.C. § 102, "a claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." M.P.E.P. § 2131 (quoting *Verdegaal Bros. v. Union Oil Co.*, 814 F.2d 628, 631, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987)). The failure of Tacke et al. to expressly or inherently describe catalysts bound to a polymer wherein the polymer is soluble in carbon dioxide precludes an anticipation rejection of Claims 1-7 and 20.

Tacke et al. propose a "method of the continuous hardening of unsaturated fats, fatty acids, or fatty acid esters on a shaped catalyst in the fixed bed" of a traditional reaction vessel. *See, Tacke et al.* at col. 1, lines 11-13. In the method of Tacke et al., a supercritical solvent medium and reactant are fed to a reactor filled with a catalytic material. A reaction occurs

between the reactant and the catalytic material, producing a product of the hydrogenation reaction that may be precipitated as a liquid or solid from the reaction mixture. *See, Id.* at col. 5, lines 52-56. "Conventional equipment can be used for the reactor apparatus" and the solvents may include carbon dioxide. *See, Id.* at col. 3, lines 1-3 and col. 5, lines 2-3. The catalysts used as packing material in the reactor may include "all known hydrogenating catalysts." *See, Id.* at col. 3, lines 23-25. The catalysts are distributed on supports, which are packed into the reactor according to traditional fixed bed reactor systems. Support materials in fixed bed reactor systems are inert to the reaction media because they must remain in the fixed bed. If such supports did not remain in the fixed bed, continuous operations would not be possible.

Tacke et al. describes the catalyst supports in detail in the Summary of the Invention. Some of the physical properties required of Tacke et al.'s supports include the requirement that the supports "have a high specific surface" and "particularly important for the method according to the invention is also the pore structure of the supports." *See, Tacke et al.* at col. 3, lines 34-38. The Tacke et al. catalysts "must be deposited finely distributed on the support, in order to provide as great a metal surface as possible for the catalytic process." *See, Id.* at col. 3, lines 60-63. The "geometric surface relative to the total volume of the bed" of the catalyst covered supports "benefits the catalytic activity of the catalyst bed." *See, Id.* at col. 4, lines 28-29. According to Tacke et al., these properties may be achieved with various support structures. For instance:

> The catalyst supports can be of any shape. There are suitable in particular all shapes known for <u>fixed bed catalysts</u>, namely spheres, cylinders, hollow cylinders and open wheels as well as monolithic catalyst supports in the form of honeycomb elements with parallel flow channels or foam ceramics with an open pore system. *See, Tacke et al.* at col. 4, lines 6-11 (emphasis added).

Such support systems are known and used with fixed bed reactor systems. In such cases, the support structures are inert to the reaction media.

Tacke et al. also describes the types of materials that may be used to form the support structures used in its fixed bed reactors:

> Various materials are suitable as catalyst supports. The materials must however satisfy the above-mentioned requirement as regards their physical properties and be <u>resistant to the reaction media</u>, in particular to the fatty acids. For the conventional fat hardening, activated carbon, silicon dioxide, aluminum oxide, mixed aluminum/silicon oxides, barium sulphate, titanium oxide, glass beads coated with titanium oxide and ion-exchange resins have proved satisfactory. *See, Tacke et al.* at col. 4, lines 34-46 (emphasis added).

Each of the materials described is inert to the reaction media and any solvent in which the reactants are dissolved. Thus, the various support materials described by Tacke et al. are necessarily inert to, or insoluble in, carbon dioxide.

Tacke et al. also proposes other materials as support structures. In particular:

> The above-mentioned requirements are however met in an optimal manner by organosiloxane amine copolycondensates or by polymeric, secondary and/or tertiary organosiloxane amine compounds or by organosiloxane polycondensates. These support materials are described in the German patent specifications DE 38 00 563 C1, DE 38 00 564 C1, DE 39 25 359 C1 and DE 39 25 360 C1. *See, Tacke et al.* at col. 4, lines 47-54.

Like the other proposed support structures, the organosiloxane amine copolycondensates support structure materials for use in the Tacke et al. fixed bed reactor must be inert to the reaction media and are <u>not</u> soluble in carbon dioxide.

Tacke et al. does not expressly propose that its catalytic support structures are soluble in carbon dioxide as recited in the claims. Likewise, the German references cited by Tacke et al. do not expressly disclose polymer support structures that are soluble in carbon dioxide. Rather, the anticipation rejection of Claims 1-7 and 20 under 35 U.S.C. § 102(b) over Tacke et al. is maintained by the Office on the basis that "the reference Tacke et al. (5,734,070) discloses a hydrogenation process involving the use of a composition with components corresponding to those claimed by applicants in the presence of carbon dioxide." *See, Final Action* at p. 5, ¶ 4. It is argued, in particular, that Tacke et al.'s organosiloxane fixed bed catalytic structural supports "inherently discloses a composition having corresponding characteristics to those claimed by applicants under like conditions." *See, First Advisory Action* at Continuation Sheet. There are no facts or sound technical reasoning provided in the record, in Tacke et al., or in the German

applications referenced by Tacke et al., which support the Office's claims that the support structures of Tacke et al. are soluble in carbon dioxide.

The Specification of the present invention does not indicate that the organosiloxane amine compounds disclosed by Tacke et al. would be soluble in carbon dioxide as alleged by the Final Action. Instead, the Specification indicates that "examples of CO_2-philic groups include silicone-containing groups or polysiloxanes, halogen (particularly fluorine) containing groups or halo (particularly fluoro)carbons, and branched polyalkylene oxides and fluorinated polyethers." *See, Specification* at p. 6, line 32 to p. 7, line 2. The Specification also indicates that "exemplary siloxane-containing segments include alkyl, fluoroalkyl, and chloroalkyl siloxanes. More specifically, dimethyl siloxanes and polydimethylsiloxane materials are useful." *See, Specification* at p. 7, lines 24-27. These teachings do not inherently disclose that Tacke et al.'s organosiloxane amine compounds have corresponding characteristics to those claimed by the applicant. Furthermore, the Specification describes both soluble and swellable polymer structures that include CO_2-philic groups, whereas only soluble polymers are recited in the pending claims.

"In relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic <u>necessarily</u> flows from the teachings of the applied prior art." *See, M.P.E.P. § 2112* (*citing, Ex Parte Levy*, 17 USPQ2d 1461, 1464 (Bd. pat. App. & Inter. 1990)(emphasis in original)). Such a basis has not been established. Tacke et al. discloses organosiloxane amine compounds for use as support structures in fixed bed reaction systems. The Specification does not indicate that <u>all</u> polysiloxanes are soluble in carbon dioxide. Rather, the Specification indicates that polysiloxanes are examples of CO_2-philic groups. The CO_2-philic groups may be used in the formation of polymers that are <u>soluble or swellable</u> in carbon dioxide. Therefore, solubility alone is <u>not</u> an inherent characteristic that <u>necessarily</u> flows from the inclusion of a CO_2-philic group in a polymer. Tacke et al.'s organosiloxane amine compounds are not

inherently soluble in carbon dioxide and therefore do not anticipate Claims 1-7 and 20. *See, Verdegaal Bros. v. Union Oil Co.*, 814 F.2d 628, 631, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987).

The inherency argument proffered by the Office also fails because the supports of Tacke et al. do not have characteristics that are similar to polymers that are soluble in carbon dioxide and fixed bed catalytic supports are not used under "like" conditions. The Office maintains its argument that "the composition of Tacke et al. are still considered to be [the] same as those claimed by applicants (Pd, Rh, Ru, or Pt supported on an organosiloxane). As a result, Tacke et al. inherently discloses a composition having corresponding characteristics to those claimed by applicants under like conditions." *See, First Advisory Action* at Continuation Sheet. Applicants <u>do not</u> claim a catalyst "supported on an organosiloxane." Claim 1 recites a <u>method</u> involving "a catalyst bound to a polymer…wherein the polymer is soluble in carbon dioxide," which <u>method</u> is not inherently taught by Tacke et al. An organosiloxane support as taught by Tacke et al. does not share the same characteristics as the claimed polymers and is not used under the same conditions. Tacke et al. discloses catalytic supports used in fixed bed reactor systems. Those of skill in the art would recognize that catalytic supports in fixed bed reactor systems must maintain their support integrity and could not be soluble. Indeed, Tack et al. recognizes this fact by specifying the physical properties that the suitable catalytic supports must have. Soluble catalytic supports would not have the desired characteristics of surface area, pore size, and pore structure required by Tacke et al. Thus, the characteristics of the support structures of Tacke et al. are not the same as those of the claimed polymers and the conditions in which they are used are not similar.

Furthermore, the Office admits that "the reference of Tacke et al. is silent about the characteristics of the catalyst in the presence of carbon dioxide." *See, Second Advisory Action* at Continuation Sheet. Tacke et al. cannot disclose "corresponding characteristics to those claimed by applicants under like conditions" when it is admitted that Tacke et al. is silent as to such characteristics under the same conditions. In light of this dichotomy, Tacke et al. does not inherently disclose all of the elements of the claims.

Tacke et al. neither expressly nor inherently discloses a method employing a "catalyst bound to a polymer...wherein the polymer is soluble in carbon dioxide" as recited in Claim 1. The lack of such a disclosure precludes an anticipation rejection under 35 U.S.C. § 102 because each and every recitation of Claim 1 is not expressly or inherently disclosed by Tacke et al. *See, Verdegaal Bros. v. Union Oil Co.*, 814 F.2d 628, 631, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987). Claims 1-7 and 20 are therefore allowable over the 35 U.S.C. § 102 anticipation rejection based upon Tacke et al.

2. 35 U.S.C. § 103(a) Rejection based on Bitler et al. and Baiker

Claims 1, 2, 4-9, 11-13, and 18-20 are rejected under 35 U.S.C. § 103(a) as being obvious in light of the combination of Bitler et al. (U.S. Pat. No. 6,255,367) with Baiker. Claims 1, 2, 4-9, 11-13, and 18-20 stand and fall together with respect to the obviousness rejection, and more particularly, Claims 2, 4-9, 11-13, and 18-20 stand and fall with Claim 1.

A *prima facie* obviousness rejection is only appropriate if certain requirements are satisfied. In particular:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, <u>and not based on applicant's disclosure</u>.

See, M.P.E.P. *§2142, citing In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991) (emphasis added). The combination of reference proffered by the Office fails to establish a *prima facie* case of obviousness against Claim 1 and those claims depending therefrom.

a) Failure to "teach or suggest all the claim limitations"

Claim 1 recites (emphasis added):

1. A method for carrying out a catalysis reaction in carbon dioxide, said method comprising:

contacting a fluid mixture with a catalyst bound to a polymer, the fluid mixture comprising at least one reactant and carbon dioxide, wherein the reactant interacts with the catalyst to form a reaction product, and wherein the polymer is soluble in carbon dioxide.

Bitler et al. teaches the formation of modifying agents comprising sharply-melting crystalline polymer structures having active chemical ingredients bonded to or otherwise associated with the polymer. "When the modifying agent is heated to the melting point of the crystalline polymeric ingredient, the modifying agent melts and flows, and as a result there is a rapid increase in the extent to which the matrix is contacted by the active chemical ingredient." *See, Bitler et al.* at col. 2, lines 28-33. Bitler et al. does not teach or suggest a method for using its modifying agent with carbon dioxide in a catalysis reaction. The Office admits this, stating that Bitler et al. "is silent about employing the disclosed compositions in the presence of carbon dioxide." *See, Final Action* at p. 3, ¶ 4. Thus, Bitler et al. alone fails to teach or suggest all the recitations of Claim 1.

Further, Bitler et al. does not teach or suggest a method for carrying out a catalysis reaction "with a catalyst bound to a polymer...wherein the polymer is soluble in carbon dioxide." The failure of Bitler et al. to teach or suggest such a method precludes the obviousness rejection.

In light of Bitler et al.'s failure to teach or suggest all of the recitations of the claims, the obviousness rejection relies upon Baiker for the proposition that hydrogenation reactions may be performed in supercritical fluids such as carbon dioxide. Even if such a combination were motivated (which Applicants contest), the combination fails to teach or suggest all of the recitations of the claims because Baiker does not teach or suggest methods of using catalysts bound to carbon dioxide soluble polymers in hydrogenation reactions. Nowhere in Baiker is the use of carbon dioxide soluble polymers mentioned. Thus, the combination of Bitler et al. and Baiker fail to teach or suggest a method for carrying out a catalysis reaction "with a catalyst bound to a polymer...wherein the polymer is soluble in carbon dioxide." The failure of the

combination of references to teach or suggest all of the recitations of Claim 1 precludes an obviousness rejection of Claim 1. *See, In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991).

b) Lack of "suggestion or motivation" to combine references

The Final Action expressly indicates that the "motivation to employ supercritical carbon dioxide during hydrogenation is the desire for greater hydrogen solubility." *See, Final Action* at p. 4. The Final Action proposes that:

> Since the reference of Bitler et al. (6,255,367) does not limit the hydrogenation conditions used in conjunction with the disclosed composition, it would have been obvious to one of ordinary skill in the art at the time the invention was made to desiring to accomplish a hydrogenation reaction to employ supercritical carbon dioxide because the reference of Baiker illustrates that it is known that supercritical carbon dioxide functions to desirably increase the solubility of the hydrogen [sic]. *See, Id.*

Bitler et al., however, does not disclose a need to improve the solubility of hydrogen using its compositions, therefore, the motivation is not found in Bitler et al. In addition, the absence of any limitations on the hydrogenation conditions used in conjunction with the Bitler et al. compositions does not equate to motivation, especially since Baiker does not indicate that the use of supercritical fluids as solvents would work with the compositions of Bitler et al. Baiker discusses the possibilities for reducing the mass transport resistance between gas (H_2) and liquid phases by working in the supercritical range. Baiker indicates that:

> Supercritical fluids (carbon dioxide, propane, ethane) have been applied advantageously as solvents in several hydrogenation reactions, including hydrogenation of fats and oils, and a great range of other organic compounds, as well as the enantioselective hydrogenation of an α-keto ester. In addition supercritical carbon dioxide has been successfully used as a reactant in the synthesis of formic acid derivatives." *See, Baiker* at p. 466, col. 1 (emphasis added).

Advantageous use of supercritical fluids in "several hydrogenation reactions" does not equate to all hydrogenation reactions and Baiker does not indicate that supercritical fluids could be applied to alleged hydrogenation reactions using the Bitler et al. compositions. Hence, there is no

motivation to combine supercritical carbon dioxide with the Bitler et al. compositions because there is no teaching supporting the alleged motivation that doing so would result in improved hydrogen solubility.

Furthermore, motivation to combine the references is lacking because Baiker teaches that there are problems associated with the use of supercritical solvents in heterogeneous catalytic reactions and that the results of the application of supercritical solvents were unknown:

> However, it should be kept in mind that the solvation power of supercritical fluids is generally lower than that of corresponding liquids, which can create a problem in the application of supercritical solvents. A potential tool to obviate the solubility problem is the tuning of the solvent properties by addition of cosolvents. This possibility has so far not been demonstrated for heterogeneous catalytic reactions, but is likely to offer great potential. Present studies on hydrogenation in supercritical media mainly capitalize on the enhanced mass transfer and solubility of hydrogen and their influence on reaction rate and selectivity. *See, Id.* (emphasis added).

In light of these teachings, one of skill in the art would not be motivated to combine Baiker with Bitler et al. because of the unresolved problems with the application of supercritical solvents in heterogeneous catalytic reactions.

The only reference that proposes a catalyst bound to a polymer that is soluble in carbon dioxide is the Specification, which cannot be used to motivate the combination of the two references. Without the teachings of the Specification, no motivation exists to combine supercritical carbon dioxide with the compositions of Bitler et al. in a catalytic reaction. Bitler et al. does not mention a desire for greater hydrogen solubility in catalytic processes using its compositions and Baiker does not indicate that supercritical carbon dioxide can be used as a solvent in all reactions, let alone a reaction using the compositions proposed by Bitler et al. To the contrary, Baiker indicates that the use of supercritical solvents is associated with problems, which were not yet solved for heterogeneous catalytic reactions. The lack of motivation precludes a *prima facie* obviousness rejection. *See, In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991).

c) Reasonable expectation of success

The acknowledgement of problems with the application of supercritical solvents in heterogeneous catalytic reactions also precludes a *prima facie* obviousness rejection because Baiker casts doubt upon the reasonable expectation of success of the combination. Neither Baiker nor Bitler et al. indicate that supercritical fluids, such as carbon dioxide, could be used with the compositions of Bitler et al. in any sort of catalytic reaction. Furthermore, Baiker indicates that the application of supercritical solvents is associated with problems. In the absence of any affirmative teaching that the compositions of Bitler et al. could be used with supercritical carbon dioxide without encountering the problems described in Baiker, there is doubt as to whether or not a catalytic reaction using the Bitler et al. compositions would be feasible in carbon dioxide. The uncertainty proposed by Baiker alone is sufficient to preclude a *prima facie* obviousness rejection because a reasonable expectation of success does not exist. *See, In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991).

Claim 1 is allowable over the 35 U.S.C. § 103(a) obviousness rejection because a *prima facie* case of obviousness is not supported by the combination of references.

Claims 2, 4-9, 11-13, and 18-20 depend from Claim 1 and stand and fall with Claim 1 in respect to the obviousness rejection because dependent claims of a nonobvious independent claim are also nonobvious. *See, In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988)(stating that if an independent claim is nonobvious under 35 U.S.C. § 103 then any claim depending therefrom is nonobvious); s*ee also,* M.P.E.P. § 2143.03.

3. Claim 49

Although Claim 49 is listed as being rejected, the record does not indicate why Claim 49 is rejected. If Claim 49 is rejected under 35 U.S.C. § 103(a) as being obvious, then Claim 49 is allowable as a dependent claim of a nonobvious independent claim because Claim 49 depends from Claim 11, which depends from nonobvious Claim 1. *See, In re Fine,* 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988); s*ee also,* M.P.E.P. § 2143.03.

CONCLUSION

On the entire record and in view of all the cited references, Appellants submit that Claims 1-9, 11-13, 18-20 and 49 are not anticipated and are nonobvious. Accordingly, it is respectfully requested that the Examiner's conclusions be reversed, and that this case be passed to issuance.

Respectfully submitted,

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Sloan Smith